The STAR Trigger

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Overview

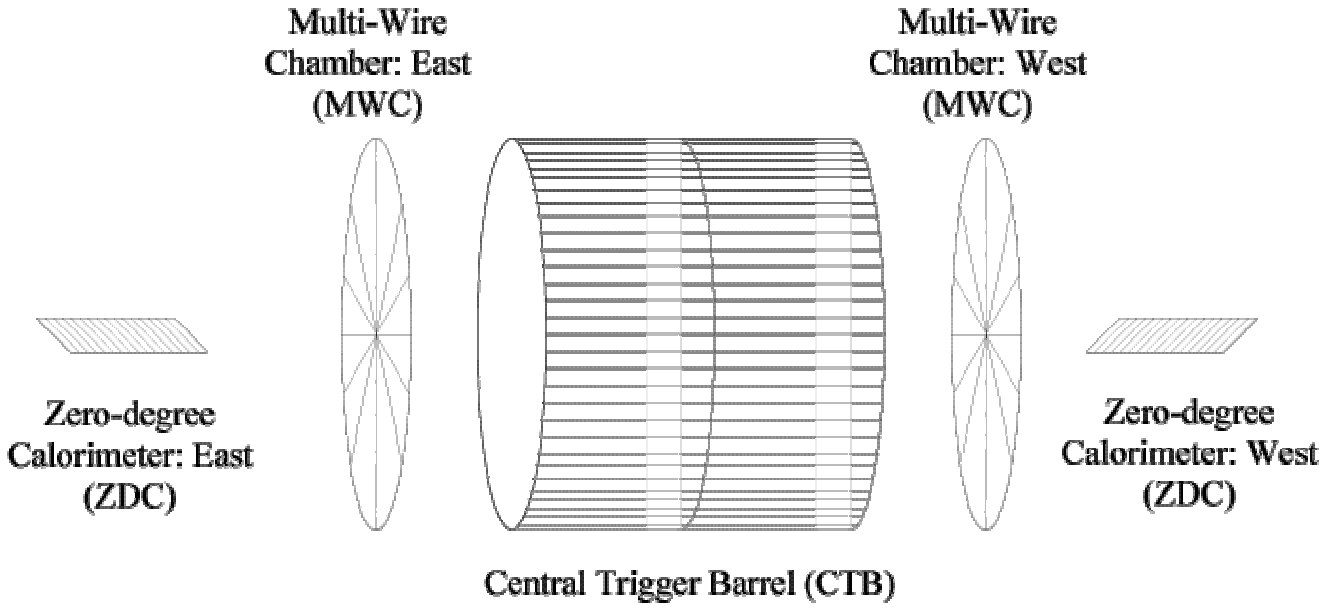
- 4 Levels -
  - Level 0 Accepts events
  - Level 1,2,3 reject events
- L0,1,2 Fully Pipelined
- Operate synchronously at 9.4 MHz
  - Analyzes events for each crossing

Technologies

- Level 0
  - Custom digitizers
  - FPGA logic tree
    - Programmable at configuration time for each run
- Level 1, Level 2
  - VME CPU farms
- Level 3
  - Alpha farm (see TL talk)

Trigger Detectors

- CTB (Central Trigger Barrel)
- MWC (Multi-Wire Chamber)
- ZDC (Zero Degree Calorimeter)
- BEMC (Barrel Electromagnetic Calorimeter)
- Have Forward Π0 (FPD) in test
- Expect BBC for protons


Multi-Wire
Chamber: East
(MWC)
Multi-Wire
Chamber: West
(MWC)
Zero-degree
Calorimeter: East
(ZDC)
Zero-degree
Calorimeter: West
(ZDC)
Central Trigger Barrel (CTB)

CTB (G.Eppley, Herb Ward)

- 120 trays, 240 slats and PMTs
  - May want to replace these for high luminosity
- $-1 < \eta < 1$ $\quad \delta\eta \sim 0.5$
- $0 < \phi < 2\pi$ $\quad \delta\phi \sim \pi/30$

MWC (A.Ogawa, V.Morosov)

- 24 sectors, 4 subsectors each
- $2 < |\eta| < 1$ $\quad\quad \delta\eta \sim 0.25$
- $0 < \phi < 2\pi$ $\quad\quad \delta\phi \sim \pi/6$
- Wires hit are counted each crossing

ZDC (Zhangbu Xu , Jason Gonzales)

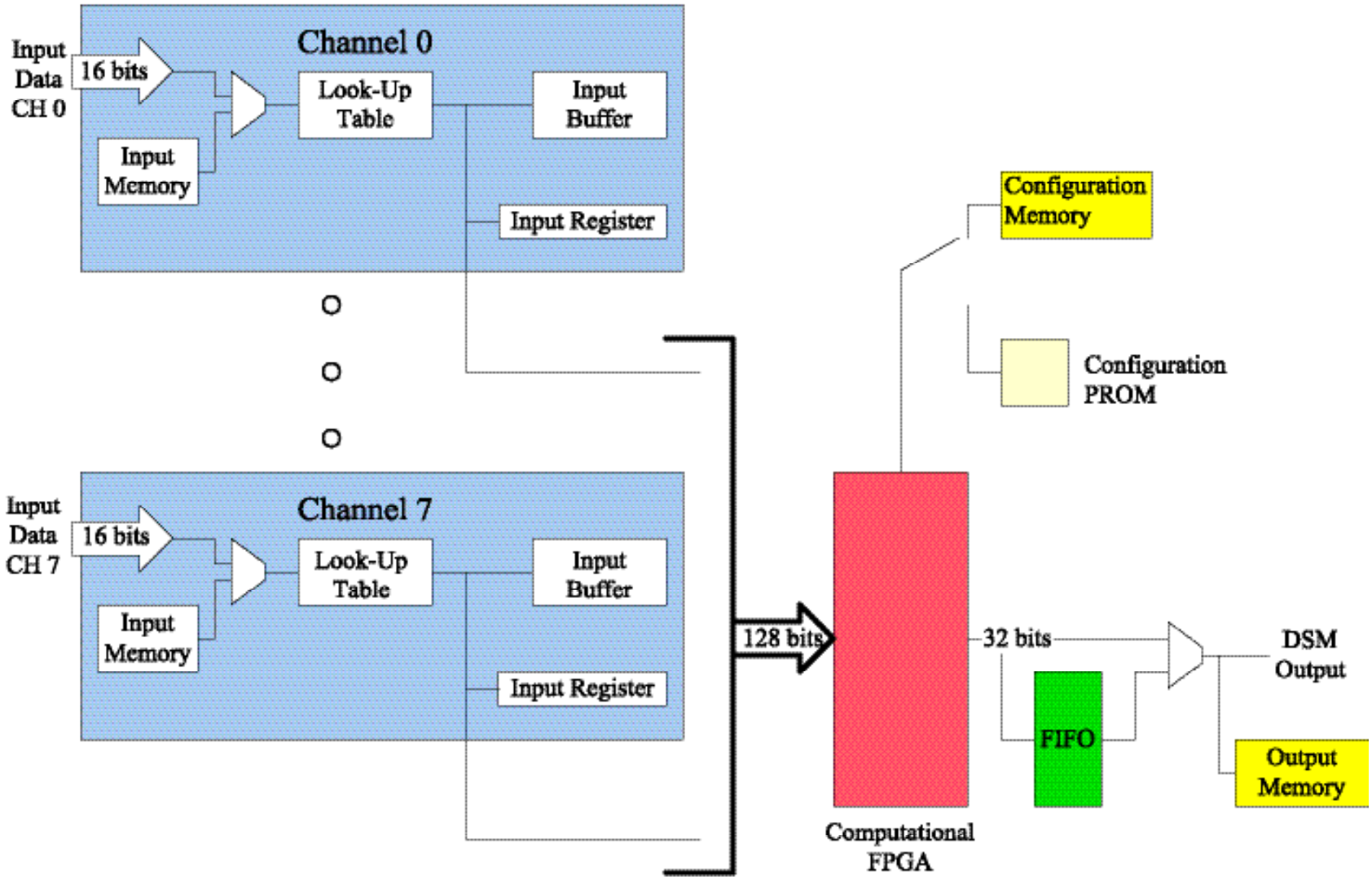
- Each PMT is digitized each crossing
- Analog sum for each ZDC digitized each crossing
- TAC for each ZDC each crossing
  - $\sigma \sim 25$ cm for low ADC signals
  - $\sigma \sim 5$ cm for large signals

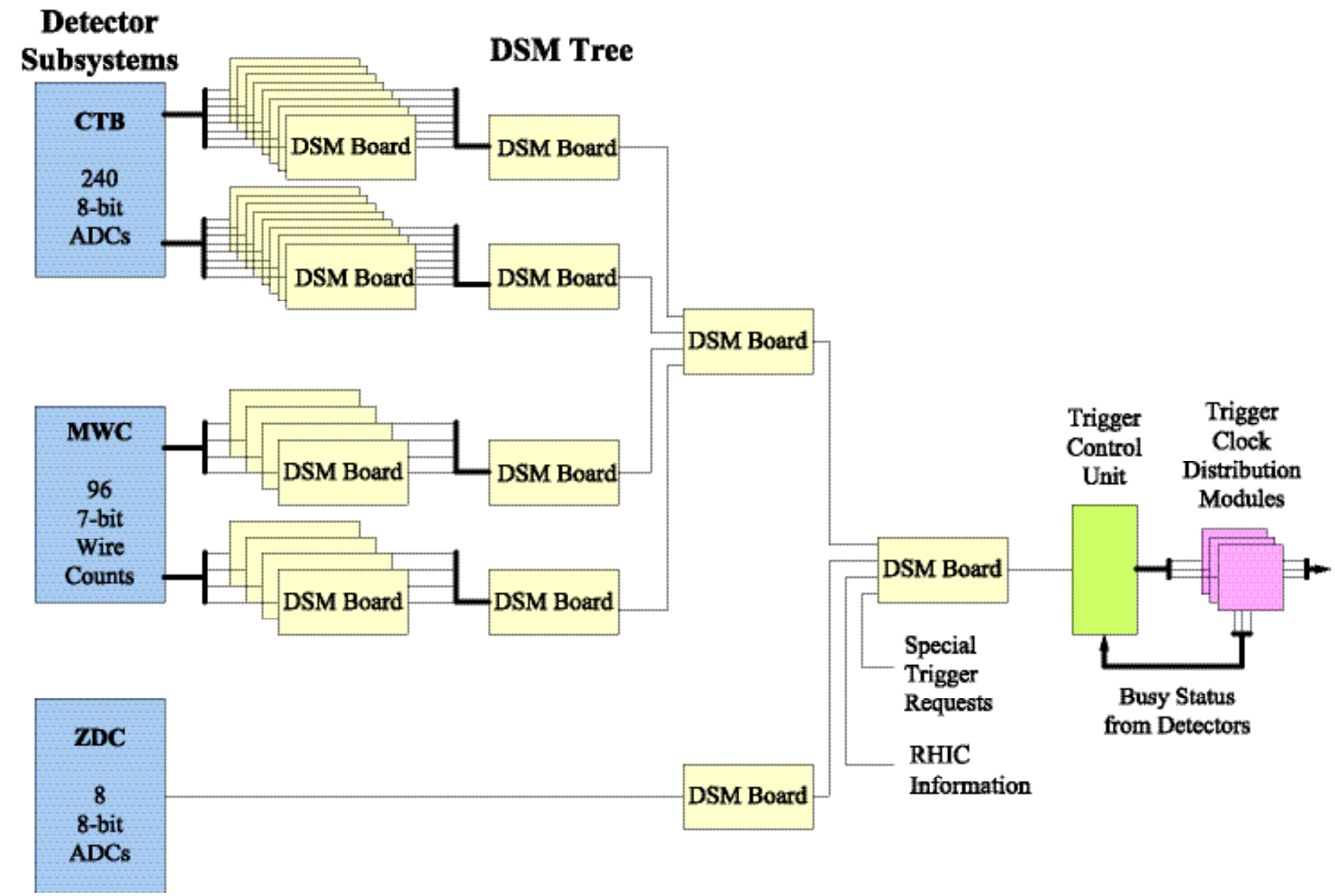
BEMC (Skip Vandermolen, Alex Suaida)

- 30 Towers instrumented into Level 0
- Level 0 selections based on:
  - 0.05 η x 0.05 ϕ high towers
  - 0.2 η x 0.2 ϕ for photons and electrons
  - 0.8 η x 1.0 ϕ for jets

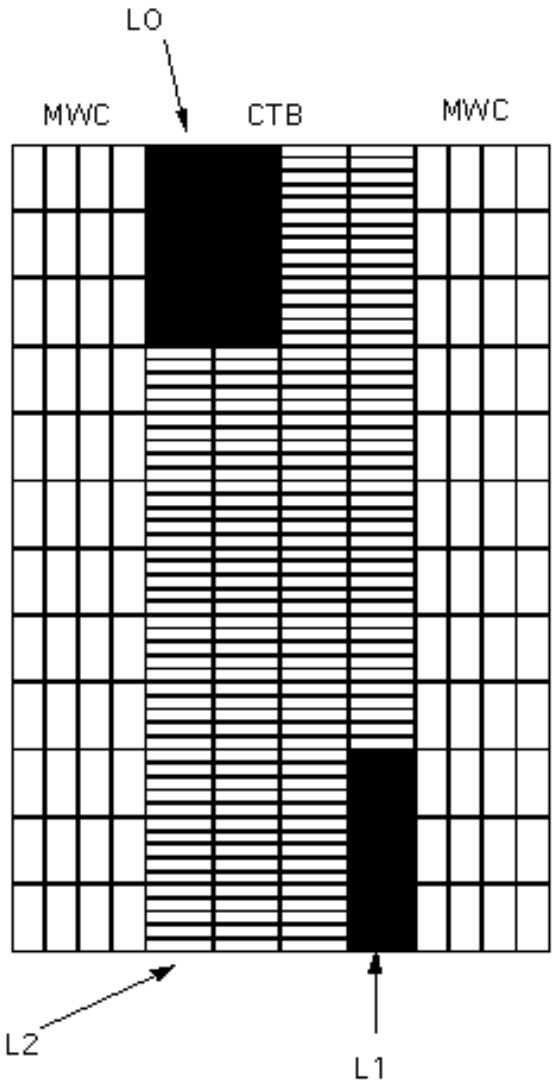
Electronics Modules (VME)

- Digitizer Boards
  - 8 bit ADC or 7 bit + timing bit, config at run time
- Receiver Boards (Glink driven)
- Data Storage and Manipulation Boards
  - 128 bits in, 32 bits out
  - FPGA for different algorithms
- Trigger Control unit
  - Index action using physics bits and detector LIVE bits


Channel 0
Input Data CH 0
16 bits
Look-Up Table
Input Buffer
Input Memory
Input Register
Channel 7
Input Data CH 7
16 bits
Look-Up Table
Input Buffer
Input Memory
Input Register
128 bits
Configuration Memory
Configuration PROM
Computational FPGA
32 bits
FIFO
DSM Output
Output Memory


Detector Subsystems
DSM Tree
CTB
240
8-bit
ADCs
MWC
96
7-bit
Wire
Counts
ZDC
8
8-bit
ADCs
DSM Board
DSM Board
DSM Board
DSM Board
DSM Board
DSM Board
DSM Board
DSM Board
DSM Board
Special
Trigger
Requests
RHIC
Information
Trigger
Control
Unit
Trigger
Clock
Distribution
Modules
Busy Status
from Detectors

Pixels in eta,phi space



Heavy Ion Triggers

- Central: (BY + ZDCE + ZDCW + M>M2) or (BY + M>M3)
- Hadronic Min Bias: BY + ZDCE + ZDCW
- Min Bias: BY + (ZDCE>0 or ZDCW>0 or M>0)
- Zero Bias: BY
- UPC/Cosmic Ray: 2<=M<=5 + topology +BY

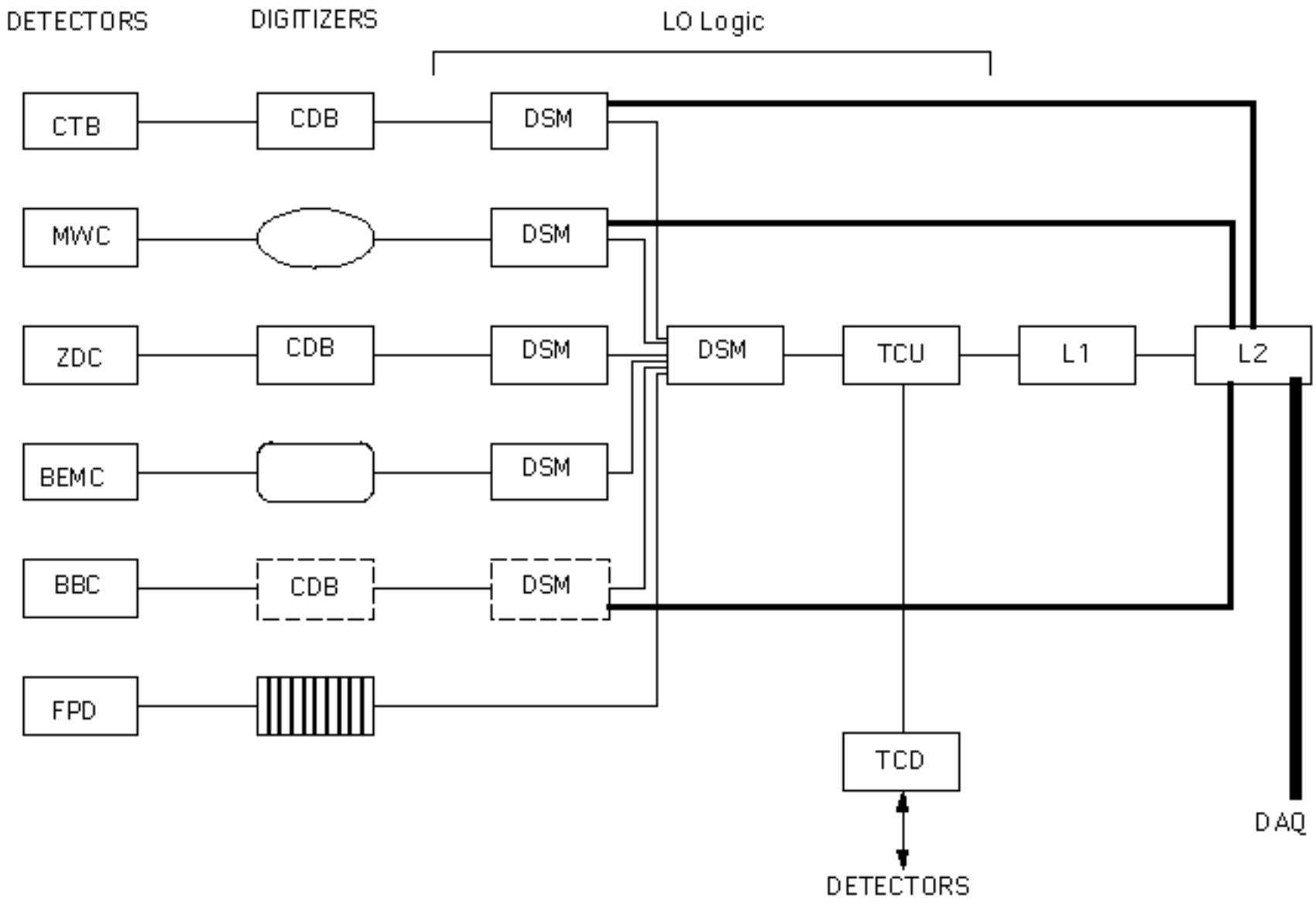
  - B = Blue ring Y = Yellow ring
  - M = multiplicity

Proton Triggers

- Zero Bias : blue and yellow
- Min Bias : BY + BBC
- Interaction: BY + MULT + topology (+BBC)
- BEMC: trigger tower, high tower, jet patch, total energy
    - BBC = Beam-Beam Counters

TCU

- Selects events based on physics content of crossing and status of each detector
- Allows >1k simultaneous triggers
- Present version:
  - 6 detector bits, 12 physics bits
- Upgrade for FY02:
  - 16 detector bits, 16 physics bits


DETECTORS
DIGITIZERS
LO Logic
CTB
CDB
DSM
MWC
DSM
ZDC
CDB
DSM
DSM
TCU
L1
L2
BEMC
DSM
BBC
CDB
DSM
FPD
TCD
DAQ
DETECTORS

11-01 HJC

Conclusions

- STAR Trigger ready for luminosity upgrades
- Ready to incorporate new detectors for spin program
- Need more selective fast detectors for specific physics interests